

MINI-REVIEW: Contribution of early intervention models to child motor development

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HIGHLIGHTS

- Early interventions did not consider the different aspects of the child development.
- Some early interventions were effective for child motor development.
- The family participated in most early intervention programs.
- Early interventions with positive results in motor acquisitions seek to assist the family.

ABBREVIATIONS

AIMS	Alberta Infant Motor Scale
C	Comparator
EI	Early intervention
I	Intervention
IBAIP	Infant Behavioral Assessment and Intervention Program
ICU	Intensive Care Unit
IPO	Operationalized Portage Inventory
O	Outcome
P	Population
RCT	Randomized clinical trials
T	Time frame
TIMP	Test of Infant Motor Performance

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BACKGROUND: Early intervention (EI) is a specific service for children in early childhood (up to two years old), in which the main objective is to promote the emergence of skills or abilities.

AIM: To identify the scientific production about EI programs and their contribution to child motor development.

METHOD: A mini-review of the literature in the PubMed, Scielo and Lilacs databases during November-December 2019, using the descriptors “early intervention” and “motor development”. Randomized clinical trials (RCT), quasi-experimental studies and case series were included. Descriptive analyses were applied.

RESULTS: Fourteen studies were selected. Some interventions were found to be effective: “Tummy time” (adoption of the prone position for a certain time) and the use of a treadmill for children with Down syndrome. Other results’ studies reinforced the importance of parents acting in their children’s environment and those strategies considering the insertion of the family in the intervention are able to modulate the risks to children motor development, even biological risks. The insertion of the family in early interventions was verified, highlighting the models of parental intervention and home visits.

CONCLUSION: Most EI models with positive effects on motor development are focused only on the execution of some determined technique, without considering the different aspects of the child development. However, family participation is undeniable even in these models. Strategies that show positive contribution to motor development seek to assist the family in the task of promoting environmental enrichment.

KEYWORDS: Child development | Parenting | Psychomotor performance

INTRODUCTION

Child development, from the bioecology perspective, occurs from the interaction of the “organism-environment” system. Biological factors of the child development are understood as those related to the organism (e. g. birth conditions, pathologies) and environmental factors are understood as those related to the psychosocial condition of the child (e. g. home environment, family structure, income). This bioecology perspective brings an approach to the child inseparable from its context (family, society, etc.)¹. Thus, some risks can affect child development, such as the biological risk (e. g. prematurity) or the environmental risk (maternal depression, low educational level, family income, home environment lacking opportunities). When risks are present, monitoring development through standardized assessments, and directing the practice of early intervention (EI) are

necessary strategies ².

Although developmental delay can be seen in early childhood, its repercussions can extend into adulthood ³. In this sense, EI programs and related services, which help to improve the prospects of development trajectory for health throughout life, should be adequately offered to children. EI is a specific service for children in early childhood (up to two years old) that uses approaches and/or techniques to promote an effective emergence of the child's skills. EI also aims to reduce delays and disabilities, in addition to promoting the adaptation of parents so that it is possible for the overall functioning of the family ⁴.

EI models have undergone major changes seeking to achieve more positive results for child development. Initially, these programs were directed and centered on the child and, later, on the professional. When the children themselves were considered to be able to be included as participants in directing the intervention, EI models were centered on the child and its family, and, currently, they seek to facilitate parent-child interaction and guide parents on opportunities for motor activities for babies ⁵.

The observation that children on EI programs are in a better position to face the challenges of schooling (which may be able to provide better indices for the educational system) highlight the importance of EI for children with developmental delay ⁶. Despite this, there are few studies focused on EI models and these studies have demonstrated that the effects of intervention programs vary according to the service provided ⁷.

In the search for evidence, it is still possible to observe a diversity of programs provided associated with the diversity of environments in which the intervention service is provided ⁸. Because of this, there may be divergences between the recommended practices and those performed in the services, both in relation to the forms of elaboration of the intervention, as well as in the relationship between the theoretical model and the applied practice ⁹. The adaptation of available interventions and their adequate offer is still a challenge, whereas it is necessary for the professional to use various elements that are effective separately. Thus, the aim of this review was to identify the scientific production about EI programs in order to answer the question: what EI programs are described in the scientific literature, and what are their results to child motor development? The hypothesis of this study is that the EI models are scientifically consolidated through favorable results for child motor development, with higher scores on the motor development scales for children who received the intervention.

METHODS

This is a mini-review of the literature about EI and their effects on the child motor development. The study was developed following the recommended steps for the elaboration of a review: (i) identification of the theme and question of the study; (ii) determining the location and selection criteria; (iii) evaluation of the selected studies; (iv) collecting data of interest to the study; (v) data analysis and presentation; (vi) interpretation and improvement of the review. The question of the review was structured through the PICOT clinical question: (P) Population - Children up to two years old; (I) Intervention - Early intervention; (C) Comparator (Control or Comparison) - compared to the conventional care or any other type of intervention; (O) Outcome - Improvement of motor development and (T) Time frame (Time) - without a set time interval for the duration of the intervention¹⁰.

In order to select the studies, randomized clinical trials (RCT), quasi-experimental studies and case series that answered the question established in this mini-review were included. It is important to justify this choice by including studies in addition to clinical trials, which addressed any group of children up to two years old, published in English, Spanish or Portuguese and at any time in an attempt to obtain a broad view of the early intervention models effects on motor development.

Two reviewers performed the search at different and independent moments during November and December 2019, in the PubMed, Scielo, and Lilacs databases. Data search was performed through an advanced search with the following exact descriptors throughout in the article: “early intervention” and “motor development”, with their Portuguese equivalents, using the Boolean term AND for crossing the descriptors. The year of publication of the articles was not determined. The eligibility stage consisted of including only studies that had both descriptors in the title and excluding studies with samples of children older than two years old, duplicate studies, non-interventionist studies, review studies, pilot studies, and clinical trial protocols.

A spreadsheet (Excel, Microsoft Office 2010®) was created to catalog the data of each selected study (year of publication, name of the journal and circulation, type of study, characteristics of the population served, characteristics of the intervention, study location, and location of the intervention). Descriptive analysis was used to present the absolute frequency of articles regarding the type of study, language of publication, instrument used to assess motor development, and location of the intervention.

Data were categorized by the model of intervention, and the results of the study were presented and discussed in a descriptive and qualitative way. Regarding the intervention models, the denomination of the authors of the studies was used, whether they called them family-centered or not family-centered. When these interventions are not called family-centered, the name that the authors gave to the studied intervention was placed in parentheses. The main results obtained from the intervention were placed at the conclusion of the studies.

RESULTS

Figure 1 shows the flowchart for the study's selection process in this review. Thus, 14 studies (full read) composed the final result of this mini-review.

Eleven selected studies were found in PubMed, one in Lilacs, and two in Scielo databases. All studies were published in English. The types of the studies included were: RCT (n=8), quasi-experimental (n=4), case series (n=2). The studies found are described in Table 1.

Nine intervention studies used the Bayley Scale of Infant and Toddler Development in some of its versions to assess motor development and three studies used the Alberta Infant Motor Scale (AIMS). The Test of Infant Motor Performance (TIMP) and Operationalized Portage Inventory (IPO) were used by one study each. Regarding the location of intervention, the studies reported that the interventions occurred: only in an outpatient setting (n=5), only in the patient's home (n=5), Intensive Care Unit (ICU) and in the patient's home (n=2), at school (n=1), and ICU and ambulatory (n=1).

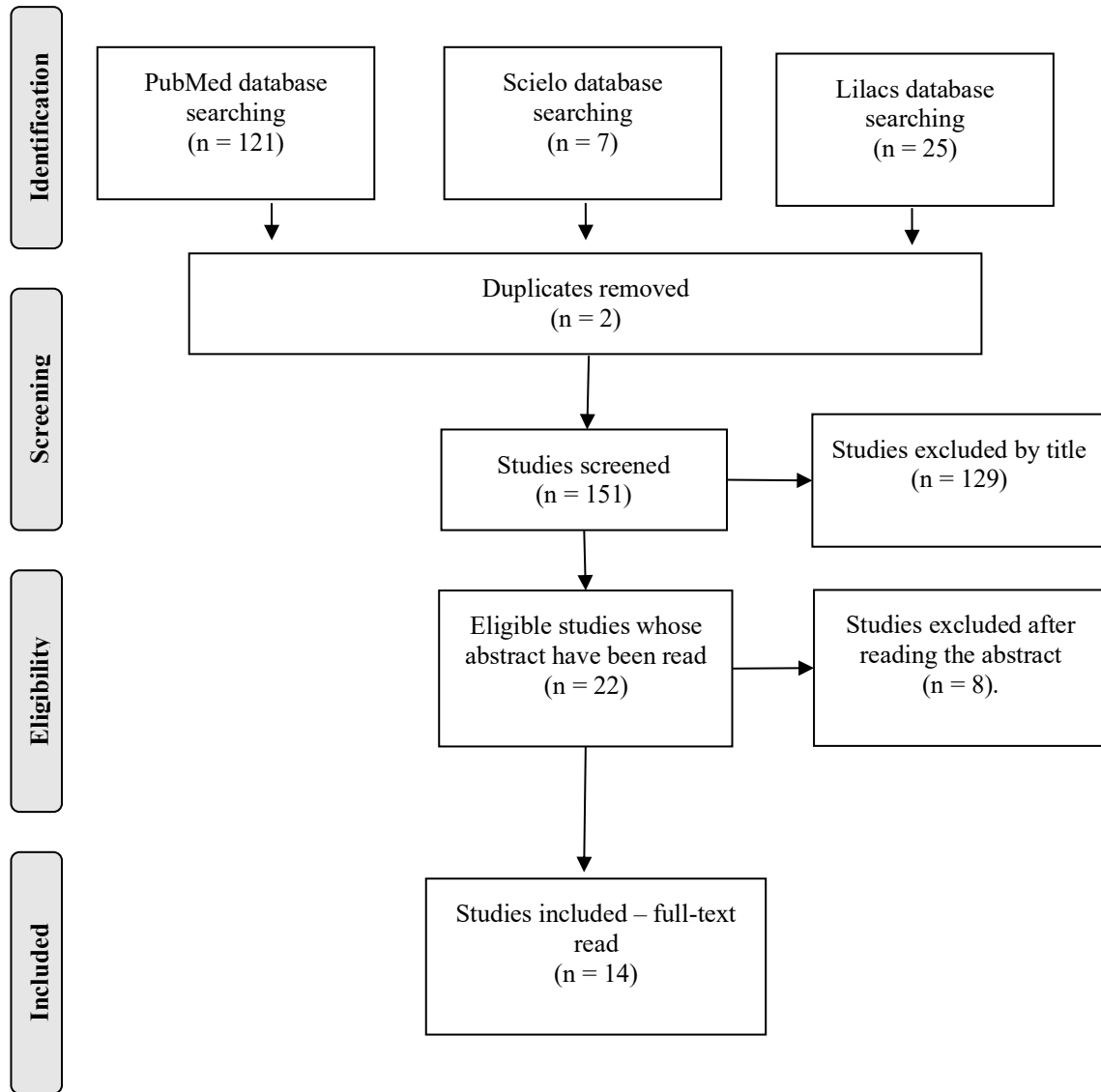


Figure 1. Flow diagram of identification and selection of studies for the mini-review.

Table 1. Characterization of the studies which evaluated the intervention effect on motor performance.

AUTHOR (YEAR)	STUDY TYPE	INTERVENTION	CONCLUSION
Brandão et al. (2019) ⁵	Quasi-experimental	No Family centered intervention (GAME)	Intervention improved the child's environment
Kara, Sahin, Yardimci, Mutlu (2019) ¹⁰	RCT	Early family-centered intervention	Interventions should support the development of fine and gross motor functions in premature infants during their first year of life
Elbasan, Fatih, Soysal-acar (2017) ¹¹	Quasi-experimental	Early family-centered intervention	Family-centered physiotherapy may not be sufficient to improve the motor and cognitive performance of premature babies in the first year of age
Wentz (2017) ¹²	Quasi-experimental	No Family centered intervention (Tummy time)	The "Tummy time" was able to reduce motor delay in babies with Down syndrome, which can be a good initial step in the intervention
Rihar et al. (2016) ¹³	RCT	No Family centered intervention (Care toy)	The proposed system is capable of affecting the effectiveness of rehabilitation for premature babies
Van Hus et al. (2016) ¹⁴	RCT	No Family centered intervention (Infant Behavioral Assessment and Intervention Program-IBAIP)	IBAIP led to long-term improvements in the intervention group, especially in babies with pulmonary broncho dysplasia
Dusing, Lobo, Lee, Galloway (2013) ¹⁵	Case series	No Family centered intervention (Intervention based on the "theory of perception-action")	An early movement experience, provided daily by parents, can improve development
Van Hus et al. (2013) ¹⁶	RCT	No Family centered intervention (Infant Behavioral Assessment and Intervention Program-IBAIP)	IBAIP improves Intelligence Quotient (IQ), ball skills and visual-motor integration 5 years after early neurobehavioral intervention
Ohgi, Fukuda, Akiyama, Gima (2004) ¹⁷	RCT	No Family centered intervention (Intervention based on the Neonatal Behavioral Assessment scale-NBAS combined with developmental support to promote family development and interaction)	The intervention has beneficial effects on neonatal neurobehavioral development and maternal mental health
Ulrich, Ulrich, Angulo-kinzler, Yun (2001) ¹⁸	RCT	No Family centered intervention (Stepping on a small motorized treadmill)	With training and support, parents can use the treadmills in their homes to help their babies with Down syndrome learn to walk earlier than they normally would
Sá et al. (2017) ¹⁹	Case series	No Family centered intervention (Parental intervention)	Early intervention protocols with parenting activities are effective in promoting normal motor development of children being followed up at a risk clinic
Formiga, Pedrazzani, Silva, Lima (2004) ²⁰	Case series	No Family centered intervention (Intervention program with and without training of mothers)	The results demonstrated that the babies of the EG obtained a greater evolution of the evaluated behaviors in relation to the CG
Formiga, Pedrazzani, Tudella (2004) ²¹	RCT	No Family centered intervention (Intervention program with and without training of mothers)	Parental participation, associated with the applied physical therapy intervention program, significantly benefited the motor development of the studied babies
Sierau et al. (2015) ²²	RCT	No Family centered intervention (The German home visiting program-Pro Kind)	The GI subgroup of high-risk mothers reported more social support and their children had higher development scores

Another important observation in this review was the large number of studies published in the past 10 years compared to previous years. Within this scope, there is the insertion of the family in the early intervention process. Some studies have made this family-centered approach clear in the title or program name^{5,10,11} and others brought some principles of this approach to the methodology, when it was noticeable that the family was an important point of the intervention that was evaluated^{14,16,17,20,22}. Few studies did not mention the family as a participant of the intervention^{12,13,18}.

Some interventions have been shown to be effective for motor development, especially for children with Down syndrome. The “Tummy time” (which is the adoption of the prone position for a certain time)¹² and the use of the treadmill generated good results for children who adhered to the strategy; in addition, it is easy for parents to carry out this intervention at home. These results reinforce the importance of stimuli offered by parents and the use of interventions focused on promoting child development¹⁸.

The Infant Behavioral Assessment and Intervention Program (IBAIP), which was reported by two selected studies, showed positive results for motor performance of preterm infants and of the subgroup of broncho dysplasia children, and remained with the benefits even when they were evaluated at five and a half years old through standardized evaluation^{14,16}. According to these studies, the IBAIP is a preventive neurobehavioral intervention that addresses both the child and the parents, and that focuses on environmental, behavioral, and developmental factors. They also explain that the intervention is guided by the Infant Behavioral Assessment, and from this assessment the physiotherapist helps parents to interact with sensibility and responsibility with their baby.

Besides parental education, another strategy was observed: the guidance for parents or caregivers, which aimed to help parents in the task of offering the necessary stimuli for their children to acquire the motor skills they need¹⁹, as well as through written explanations and guidelines of what should be done during the week as a complement to the neuro-sensory-motor intervention performed by a physiotherapist²⁰. However, it was found that this training, when performed through telephone short conversations, did not show satisfactory results¹¹.

Home visits aimed at monitoring maternal and child health were also mentioned. These visits included the child development assessment component, and the family orientation focused on the needs of the child and the family as a whole²².

DISCUSSION

The aim of this review was to identify the scientific production about early intervention programs and their contribution to child motor development. The present study obtained the spectrum of interventions that aimed to generate positive results to motor performance of children. It was possible to observe that most intervention models do not call themselves family-centered. It was possible to observe relevant results for the adoption of a prone position and treadmill for children with Down syndrome, in addition to good long-term results for premature children participating in the IBAIP program. The data obtained in the study corroborate with those found in the reviews selected, in which the family proved to be an important factor for the improvement in motor development, although further studies are still needed.

The findings reinforce the importance of parents acting in their children's environment, considering that the best results had this characteristic in common^{12,14,16,18}. Challenging environments are shown to be positive in motor acquisitions, with the environment capable of modulating the risks to which children are exposed, even biological risk. The knowledge and practice of parents, associated with the stimuli environment, are able to explain the variability of children's motor development; therefore, action at these points can promote a reduction in motor delay in children¹⁰.

The family, according to the theory of family systems²³, is perceived as a complex social system, which has unique characteristics. In this ecological view, development emerges from interactions among people within the various environments they participate in. In this type of environment, it's included: the family, the school and the community, being family the closest to the child, therefore being very important for the child development. In fact, parents' commitment to their children's development is capable of generating better results for the child and the whole family¹¹.

Regarding the insertion of the family in this process, there is a lack of robust results that demonstrate their effects on motor development; however, this type of approach has shown promise in improving parental engagement and promoting environmental enrichment of stimuli. Moreover, it has the function of reinforcing for parents the importance of adequate gross and fine motor development even in the child's first year of life^{4,11,17,20}.

In this sense, the interaction and support between families and professionals is very important for the intervention in early childhood, especially for children with motor development delay or atypical, as this interaction is able to promote self-efficacy and positive parenting beliefs. The use of family-centered practices aims to share information so that parents can make informed decisions. It emphasizes the use of a listening strategy and identification of family members' strengths and capabilities²⁴. This highlights the need for health professionals to make room for the contribution of parents, supporting them to develop confidence and competence in making shared decisions and establishing a therapeutic relationship.

Within the limitations of the present research are the small number of studies and the lack of quality clinical trials. Additionally, the interventions were very different, being tested in publics of different ages and commitments. Regarding the analysis of the interventions, there is a difficulty in replicating them since their description generally occurred in a simplified way. Besides, the result of the interventions was often analyzed from a cognitive and motor point of view, being the former more thoroughly and more often described than the latter. Thus, this study was restricted to an overview of studies about early interventions and their effects on motor development since the same, although evaluated, was little emphasized within the results found.

CONCLUSION

The presented study presented early intervention programs that aimed to promote gains in motor acquisitions for children. In the results, we have interventions named by the authors as family-centered and others that have been named otherwise, although the family is included in most of these through listening to family members or their education/training. There are still few studies that consider only the professional and/or the

child on the intervention strategies. One study concluded that family-centered physiotherapy may not be sufficient to improve the motor and cognitive performance of premature babies in the first year of age.

The majority of early intervention models that have shown positive results for motor development are still focused only on the execution of some determined technique, without considering the different aspects of the development of the child. However, family participation is undeniable even in these programs. Strategies that show positive results in motor acquisitions seek to assist the family in the task of promoting environmental enrichment, such as the “Tummy Time”, treadmill and IBAIP, which stood out in improving children’s motor development.

REFERENCES

1. Benetti IC, Vieira ML, Crepaldi MA, Schneider DR. Fundamentos da teoria bioecológica de Urie Bronfenbrenner. *Pensando Psicol.* 2013;9(16):89–99. doi.org/10.16925/pe.v9i16.620.
2. Richter L, Black M, Britto P, Daelmans B, Desmond C, Devercelli A, et al. Early childhood development: an imperative for action and measurement at scale. *BMJ Glob Heal.* 2019;4:154–60. doi:10.1136/bmjgh-2018-001302.
3. Brian A, Pennell A, Taunton S, Starrett A, Howard C, Goodway JD, et al. Motor Competence Levels and Developmental Delay in Early Childhood: A Multicenter Cross - Sectional Study Conducted in the USA. *Sport Med.* 2019;49(10):1609–18. doi:10.1007/s40279-019-01150-5.
4. Graça PRM, Teixeira MLSC, Lopes SCG, Serrano AMSPH, Campos ARS. O momento da avaliação na intervenção precoce: o envolvimento da família estudo das qualidades psicométricas do ASQ-2 dos 30 aos 60 meses. *Rev Bras Educ Espec.* 2010;16(2):177–96. doi:10.1590/S1413-65382010000200003.
5. Brandão M de B, Frota LMCP, Miranda JL, Brasil RMC, Mancini MC. Family-Centered Early Intervention Program for Brazilian Infants with Congenital Zika Virus Syndrome: A Pilot Study. *Phys Occup Ther Pediatr.* 2019;39(6):642–54. doi:10.1080/01942638.2019.1600100.
6. Franco V, Melo M, Santos G, Apolónio A, Amaral L. A National Early Intervention System as a Strategy to Promote Inclusion and Academic Achievement in. *Front Psychol.* 2017;8(July):1–7. doi:10.3389/fpsyg.2017.01137.
7. Gray R, McCormick MC. Early childhood intervention programs in the US: Recent advances and future recommendations. *J Prim Prev.* 2005;26(3):259–75. doi:10.1007/s10935-005-3600-x.
8. Marini BPR, Lourenço MC, Barba PC de S Della. Revisão sistemática integrativa da literatura sobre modelos e práticas de intervenção precoce no Brasil. *Rev Paul Pediatr.* 2017;31(4):456–63. doi:10.1590/1984-0462/2017;35;4;00015.
9. Fandino W. Formulating a good research question: Pearls and pitfalls. *Indian J Anaesth.* 2019;63(8):611–616. doi:10.4103/ija.IJA_198_19.

10. Kara OK, Sahin S, Yardimci BN, Mutlu A. The role of the family in early intervention of preterm infants with abnormal general movements. *Neurosciences*. 2019;24(2):101–9. doi:10.17712/insj.2019.2.20180001.
11. Elbasan B, Fatih M, Soysal-acar AS. The effects of family-centered physiotherapy on the cognitive and motor performance in premature infants. *Infant Behav Dev*. 2017;49(16):214–9. doi: 10.1016/j.infbeh.2017.09.007.
12. Wentz EE. Importance of Initiating a “Tummy Time” Intervention Early in Infants With Down Syndrome. *Pediatr Phys Ther*. 2017;27(1):68–75. doi:10.1097/PEP.0000000000000335.
13. Rihar A, Sgandurra G, Beani E, Cecchi F, Pasic J, Cioni G, et al. CareToy: Stimulation and Assessment of Preterm Infant’s Activity Using a Novel Sensorized System. *Ann Biomed Eng*. 2016;44(12):3593–605. doi: 10.1007/s10439-016-1669-4.
14. Van Hus JWP, Jeukens-Visser M, Koldewijn K, Holman R, Kok JH, Nolle F, et al. Early intervention leads to long-term developmental improvements in very preterm infants, especially infants with bronchopulmonary dysplasia. *Acta Paediatr*. 2016;105(7):773–81. doi: 10.1111/apa.13387.
15. Dusing SC, Lobo MA, Lee H, Galloway JC. Intervention in the First Weeks of Life for Infants Born Late Preterm : A Case Series. *Pediatr Phys Ther*. 2013;25(2):194–203. doi: 10.1097/PEP.0b013e3182888b86.
16. Van Hus JWP, Jeukens-Visser M, Koldewijn K, Geldof CJA, Kok JH, Nolle F, et al. Sustained Developmental Effects of the Infant Behavioral Assessment and Intervention Program in Very Low Birth Weight Infants at 5.5 Years Corrected Age. *J Pediatr*. 2013;162(6):1112–9. doi: 10.1016/j.jpeds.2012.11.078.
17. Ohgi S, Fukuda M, Akiyama T, Gima H. Effect of an early intervention programme on low birthweight. *J Paediatr Child Heal*. 2004;40(June):689–695. doi: 10.1111/j.1440-1754.2004.00512.x.
18. Ulrich DA, Ulrich BD, Angulo-kinzler RM, Yun J. Treadmill training of infants with Down syndrome: evidence-based developmental outcomes. *Pediatrics*. 2001;108(5):1–9. doi: 10.1542/peds.108.5.e84.
19. Sá FE de, Nunes NP, Godim E JL, Almeida AKF de, Alencar AJC de, Cardoso KVV. Intervenção parental melhora o desenvolvimento motor de lactentes de risco: série de casos. *Fisioter e Pesqui*. 2017;24(1):15–21. doi:10.1590/1809-2950/15828624012017.
20. Formiga CKMR, Pedrazzani ES, Silva, FPS, Lima, CD.. Eficácia de um programa de intervenção precoce com bebês pré-termo. *Paidéia (Ribeirão Preto)*. 2004;14(29):301–311. doi:10.1590/S0103-863X2004000300006.
21. Formiga CKMR, Pedrazzani E, Tudella E. Desenvolvimento motor de lactentes pré-termo participantes de um programa de intervenção fisioterapêutica precoce. *Rev Bras Fisioter*. 2004;8(3):239–45.

22. Sierau S, Dähne V, Brand T, Kurtz V, Klitzing K Von. Effects of Home Visitation on Maternal Competencies , Family Environment, and Child Development: a Randomized Controlled Trial. *Prev Sc.* 2015;17(1):40–51. doi: 10.1007/s11121-015-0573-8.
23. Bronfenbrenner U. La ecología del desarrollo humano: Cognición y desarrollo humano. Barcelona: Ed. Paidós; 1987.
24. Mas MJ, Dunst CJ, Balcells-balcells A, Garcia-ventura S, Giné C, Cañadas M. Family-centered practices and the parental well-being of young children with disabilities and developmental delay. *Res Dev Disabil.* 2019;94(September):103495. doi:10.1016/j.ridd.2019.103495.

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